Crystallography

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Observation of dislocations in hen egg-white lysozyme crystals by synchrotron monochromatic-beam X-ray topography

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Introduction

X-ray topography is one of the most powerful methods to study the distribution and characterization of dislocations in crystals. For protein crystals, large crystals in the millimeter-size range are required to obtain clear dislocation images by X-ray topography. To investigate the characteristics of dislocations in protein crystals, other types of protein crystals should be examined using X-ray topography. So far X-ray topography studies in tetragonal lysozyme crystals have been carried out. In this paper, we report the identification of dislocations in orthorhombic HEW lysozyme crystals by means of synchrotron X-ray topography by the monochromatic- beam technique.

Experiment

Orthorhombic HEW lysozyme crystals were orthorhombic with space group $P2_12_12_1$, lattice constants of a=56.5Å, b=73.4Å, c=30.4Å, and four molecules per unit cell. X-ray topography was carried out with synchrotron radiation in BL15B1 at the PF. The monochromatic-beam of 1.2Å was selected by adjusting the monochromator. The synchrotron radiation was strongly scattered in the test tube or glass bottle in which HEW lysozyme crystals were grown. The crystal in the test tube or glass bottle was gently transferred into a thin container, e.g. a short straw, which is transparent for the synchrotron radiation. To avoid the evaporation of water contained in the crystal, it was surrounded in the growth solution and both sides of the straw were sealed with parafilms. The sealed straw was mounted on the goniometer. A habit crystallographic face of the crystal was adjusted to be almost normal to the incident beam. For X-ray topography, an X-ray flat panel sensor was employed to find target reflections. This sensor with high sensitivity in the low energy range is very useful for monochromatic-beam X-ray topography for protein crystals. After finding the target reflections, X-ray films or nuclear plates were set and X-ray topographs were provided.

Results and Discussion

From the monochromatic-beam topograph, it is clearly observed that the dislocations are generated at or around the nucleus centre or sector boundary. In addition, it is obvious that almost all dislocations are generated as pair dislocations. From the extinction criterion, the dislocations identify to be of edge characters with [001] Burgers vector.

Fig.1 Synchrotron monochromatic-beam X-ray topograph of an orthorhombic HEWL crystal in $00\bar{2}$ reflection, taken with the incident beam almost normal to the (010) face.

References

[1] M.Koishi et al., Crystal Growth & Design 7, 2182 (2007)
[1] Y. Mukobayashi et al., Phys.Stat.Sol(a), (in press)

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